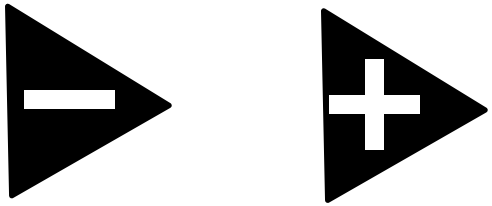
Phase I

Basic Switch Control

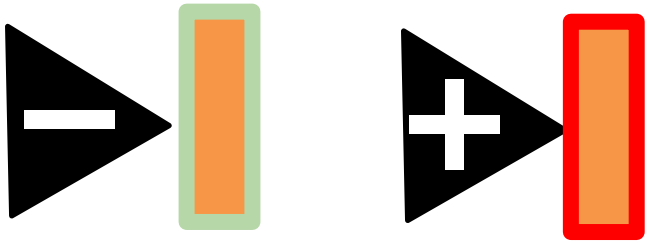
Guide to Parts



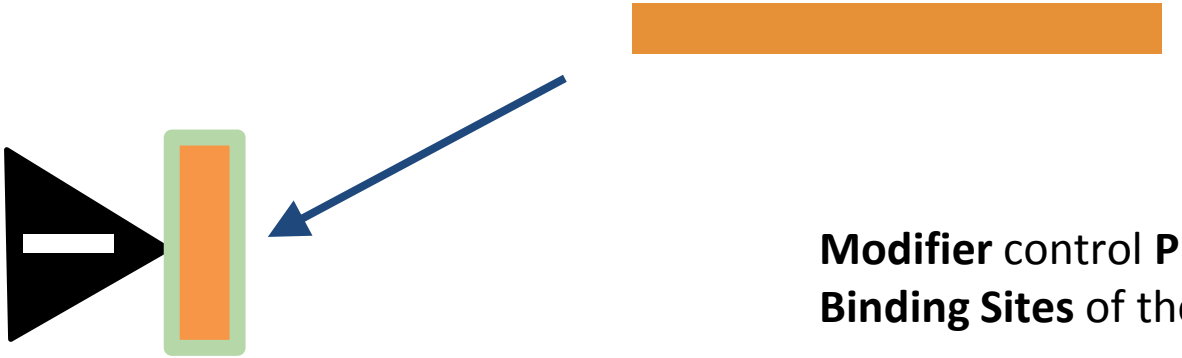
These are **Promoters**. **Promoters** drive production of **Modifiers**

These are **Modifiers. Modifiers** affect <u>all</u> **Promoters** of the matching colour

Guide to Parts

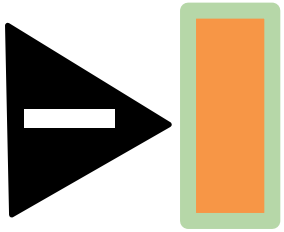


These are **Promoter Units. Promoter Units** consist of a **binding site** and a **promoter.**

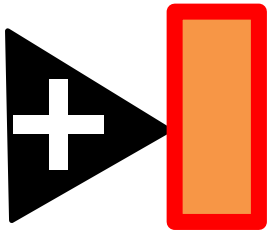


Modifier control **Promoter Units** with **Binding Sites** of the same color

Guide to Parts

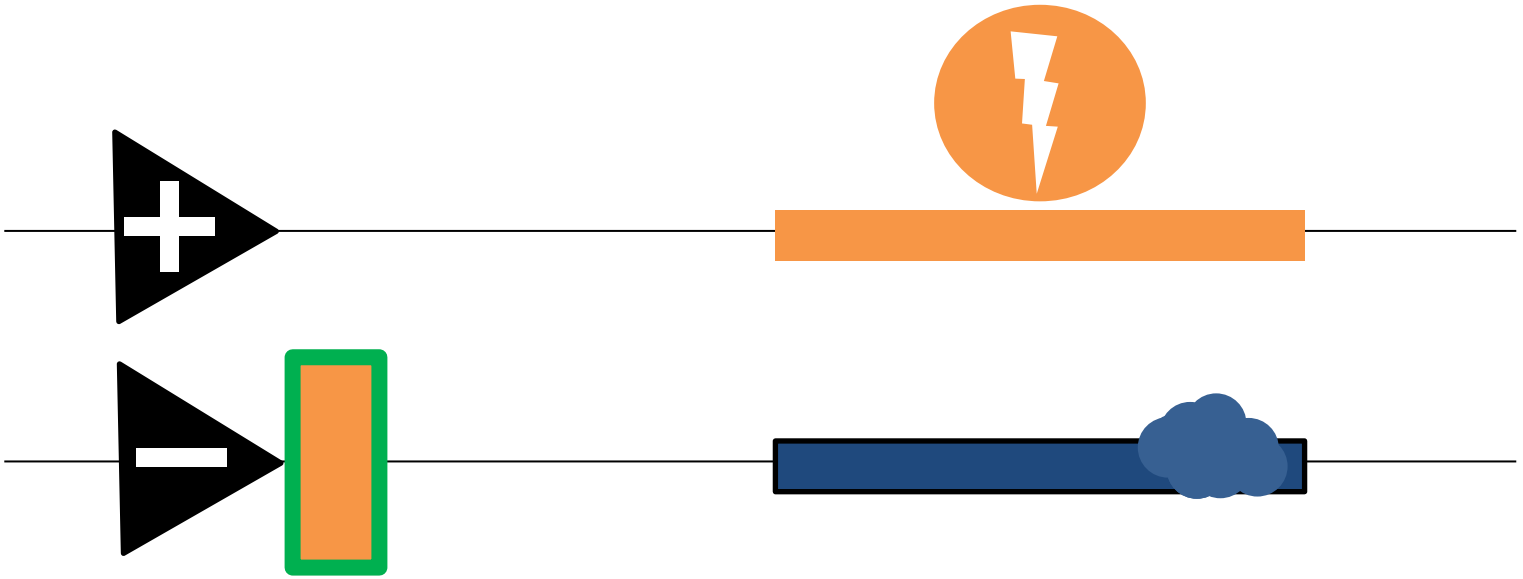


“-” Promoters are inducible. They are off by default. A **Modifier** targeting a Green-outlined **Binding site** can activate them.



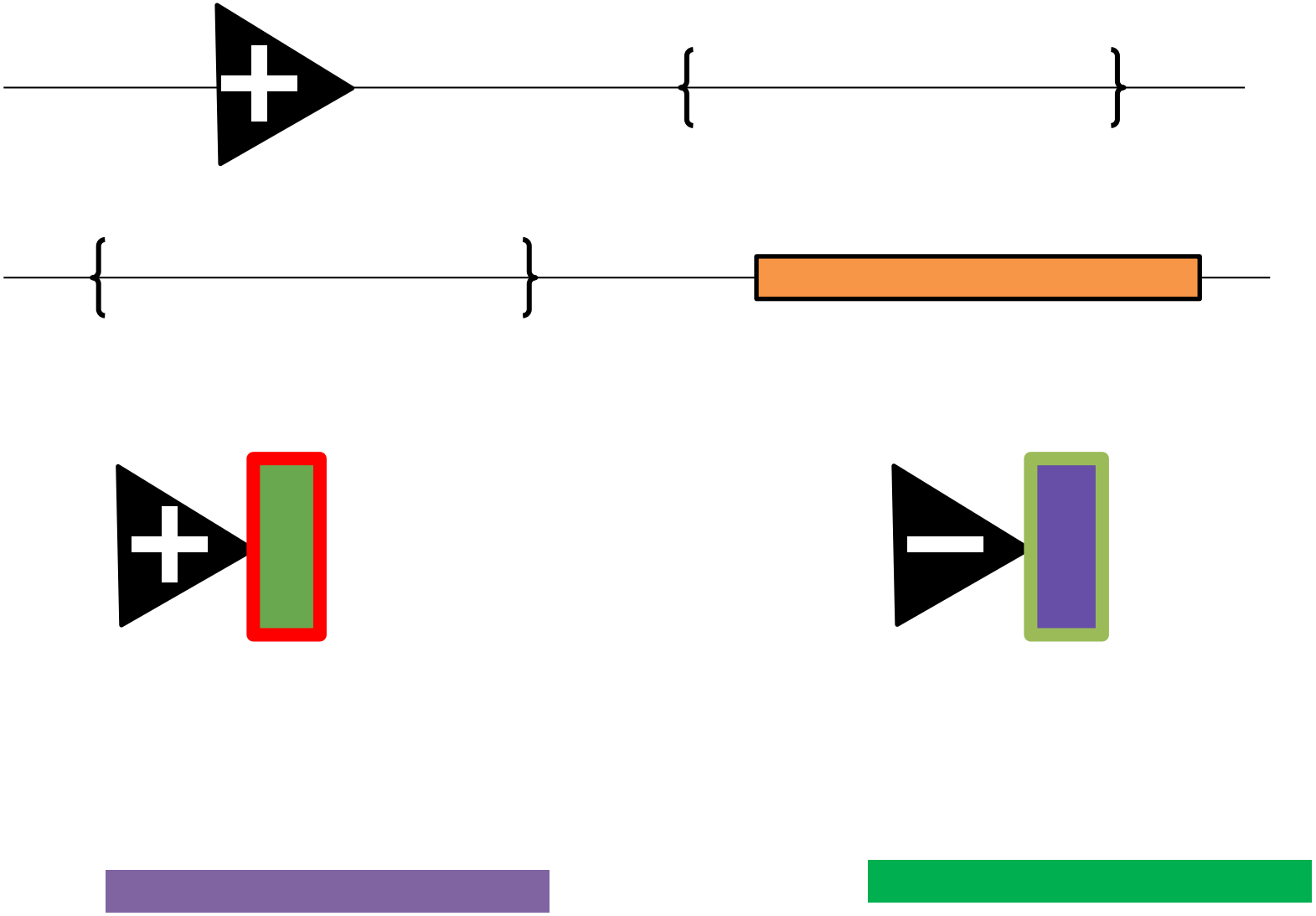
“+” Promoters are constitutive. They are on by default. A **Modifier** targeting a Red-outlined **Binding site** can deactivate them.

Guide to Parts



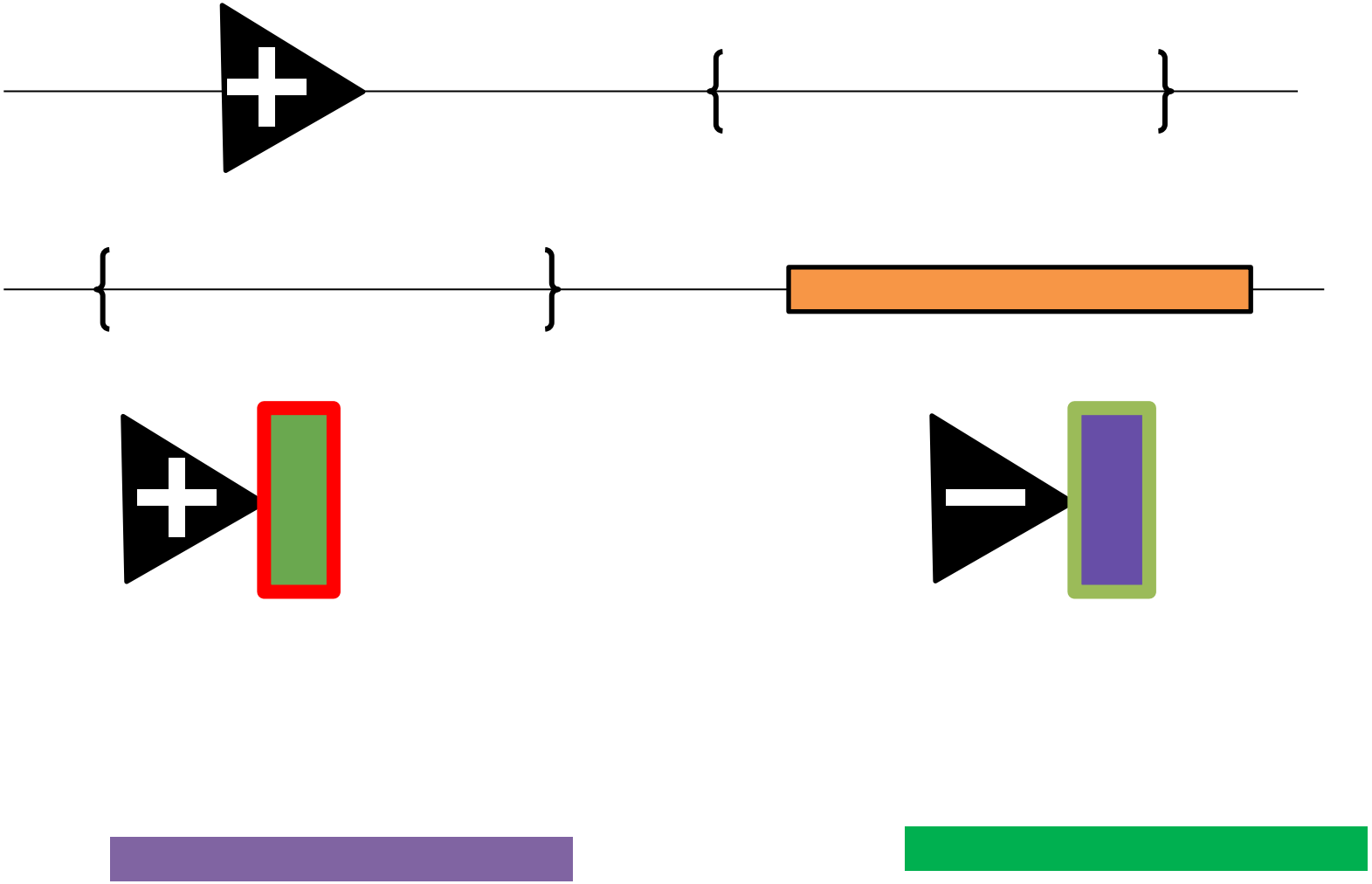
The constitutive promoter starts the expression of the ORANGE gene.
The ORANGE gene in turn SWITCHES ON the promoter with an ORANGE binding site.
The ORANGE promoter starts the expression of the BLUE gene.

Increase expression of the **Orange** gene



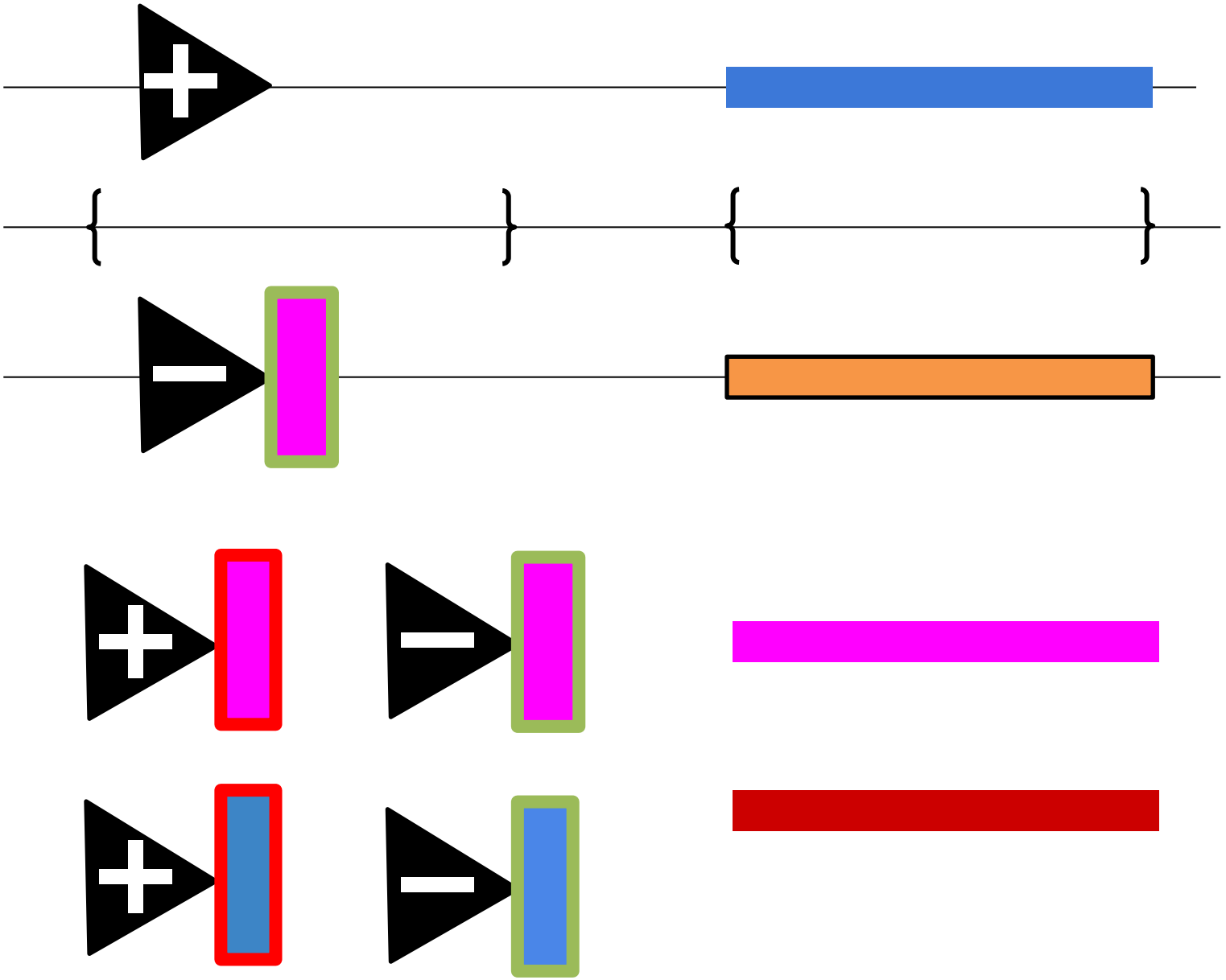
Rating: 1/10

Decrease expression of the **Orange** gene



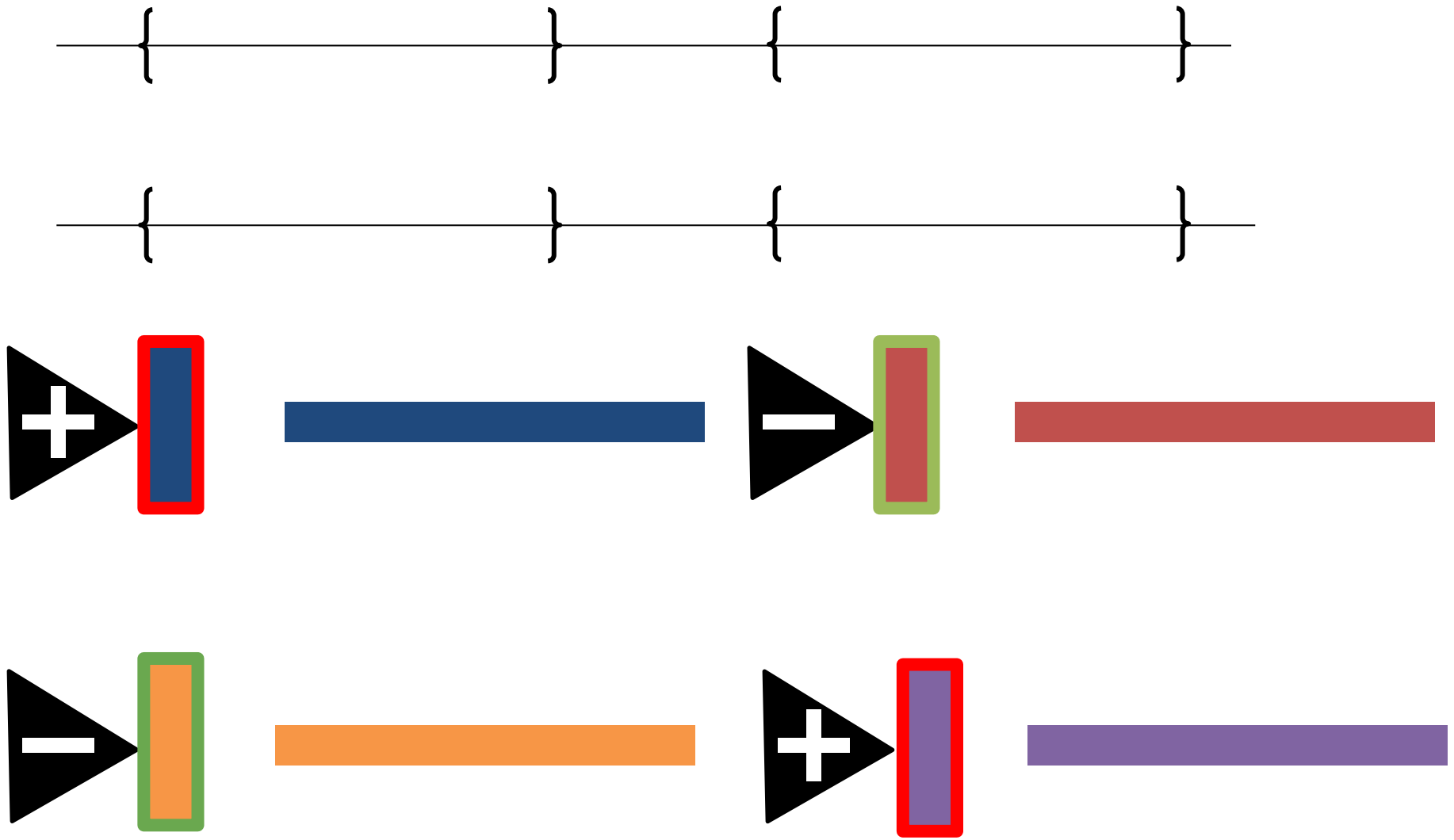
Rating: 1/10

Increase expression of the **Orange** gene



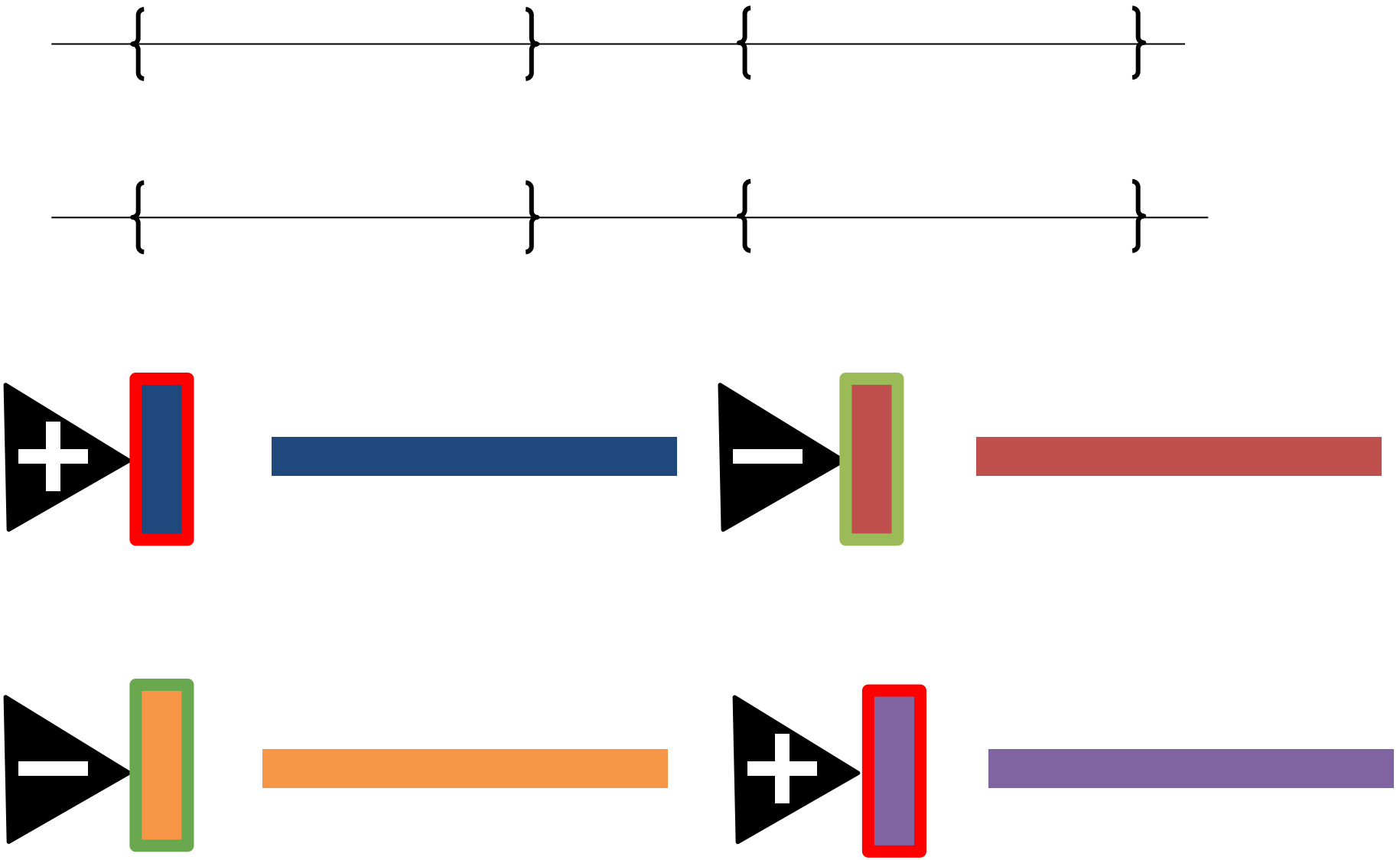
Rating: 1/10

Create a positive feedback loop (The circuit is able to activate itself)



Rating: 2/10

Create a negative feedback loop (This circuit has the ability to turn itself off)

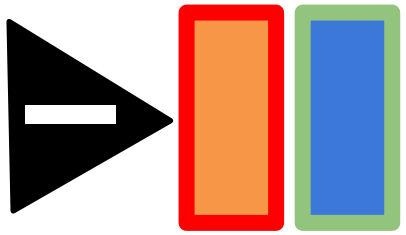


Rating: 2/10

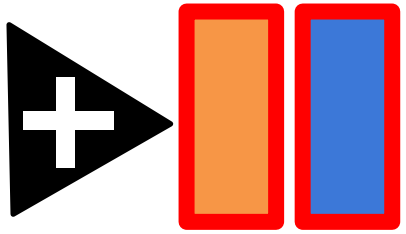
Phase II

Precise Control Systems

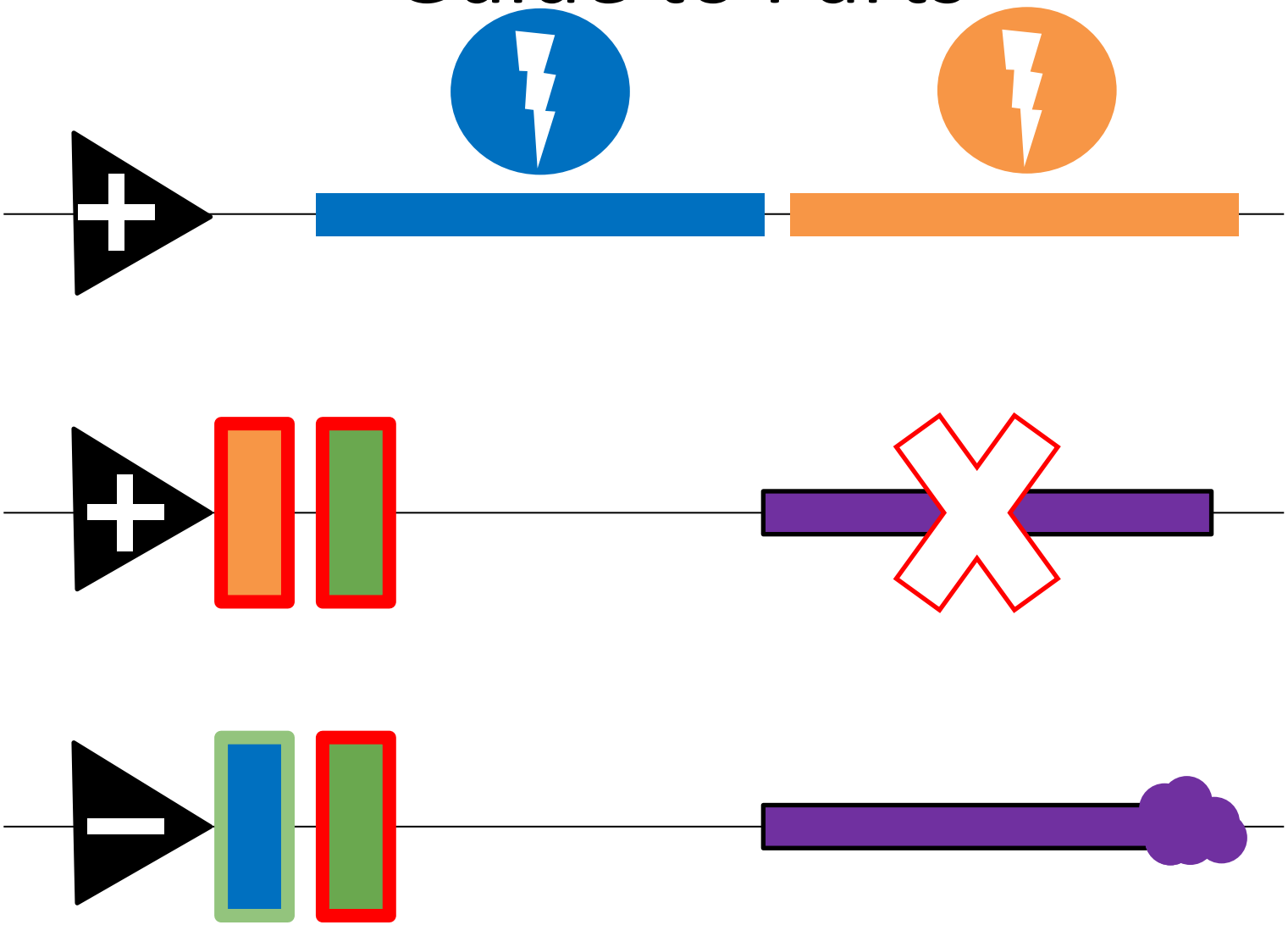
Guide to Parts



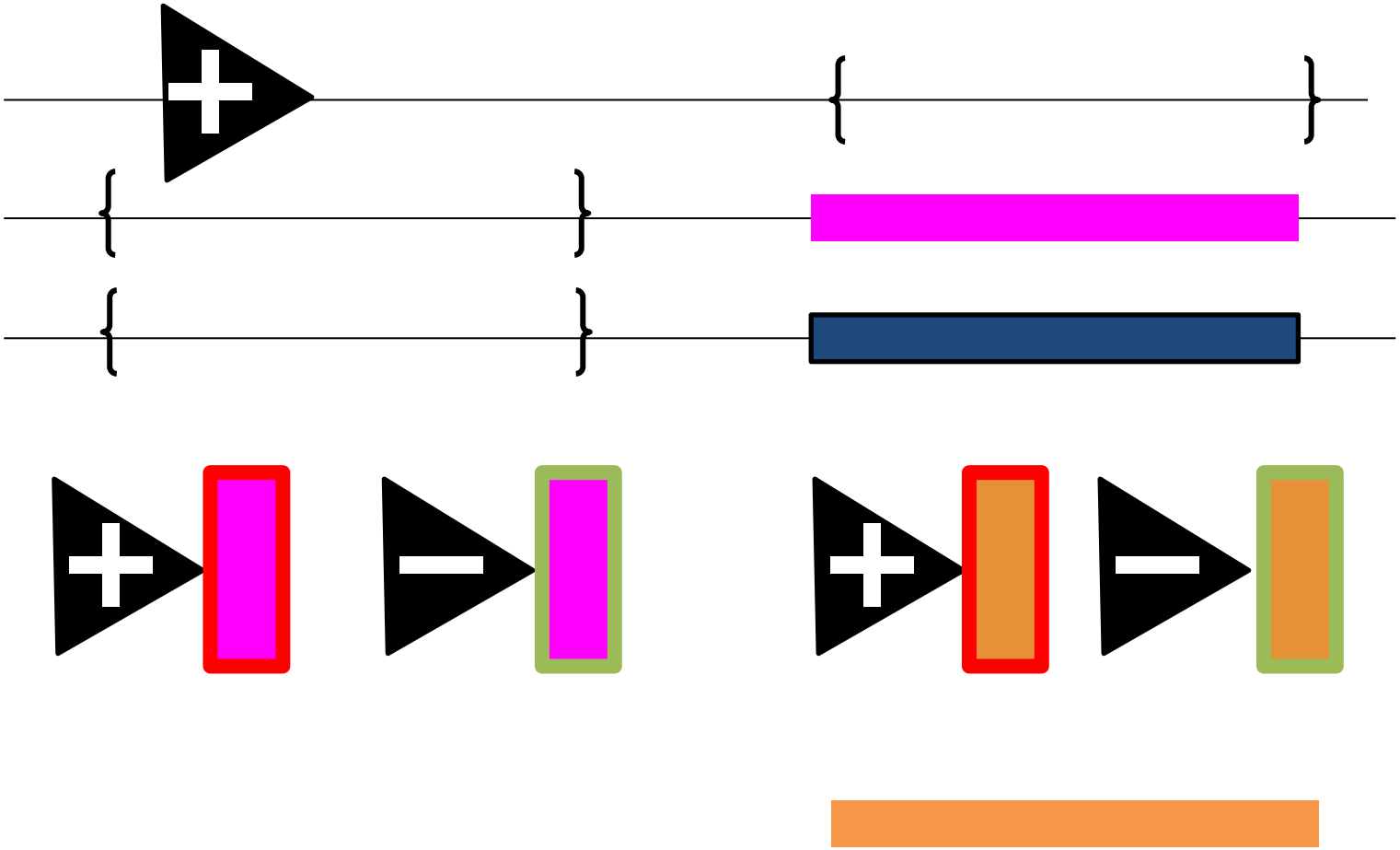
A **Promoter Unit** may have multiple binding sites. The **Promoter Unit** can only function if all activating sites are activated, and no repressing site is activated.



Guide to Parts

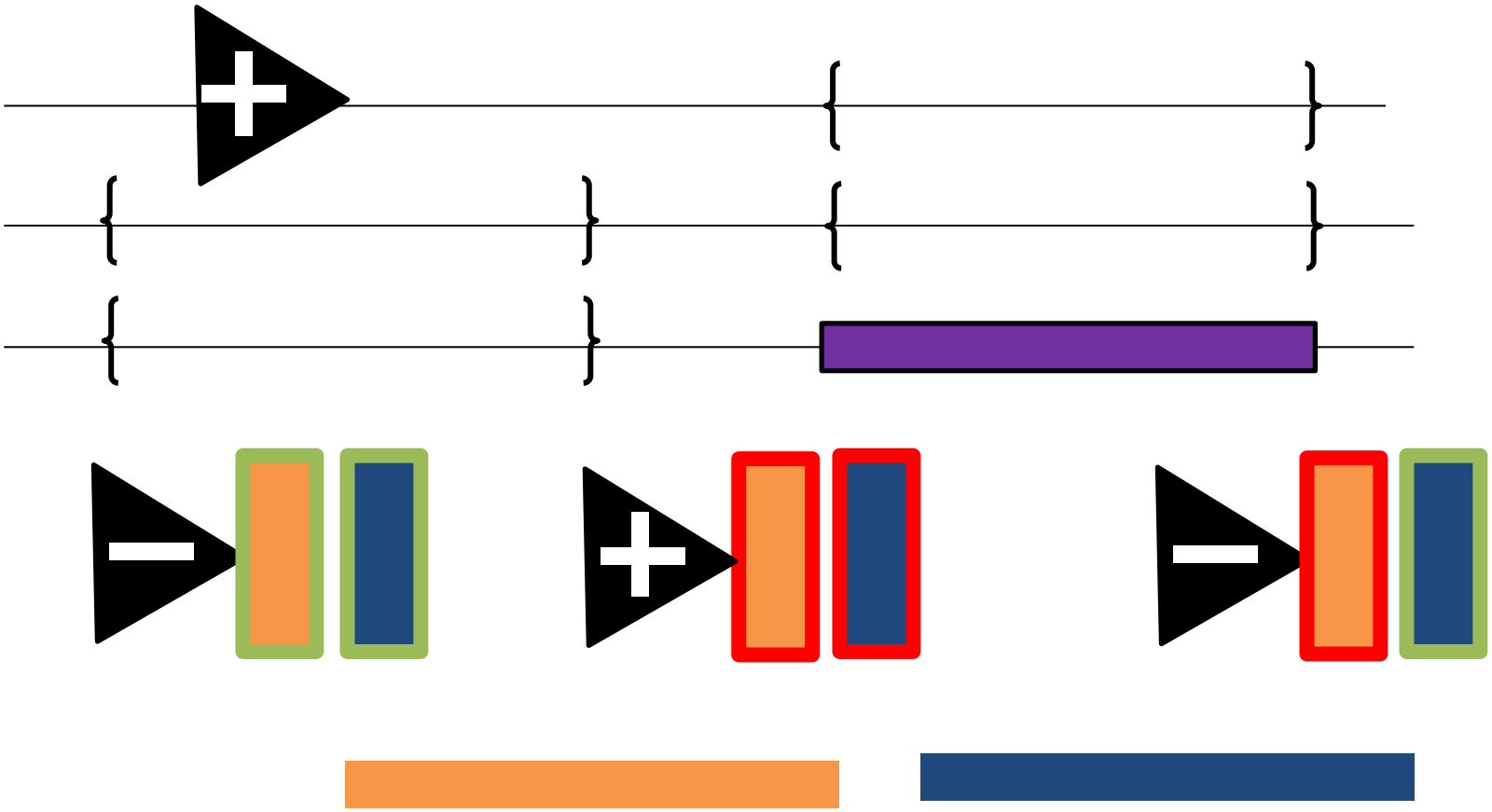


Express the **Blue** gene only when the **Magenta** gene is not expressed



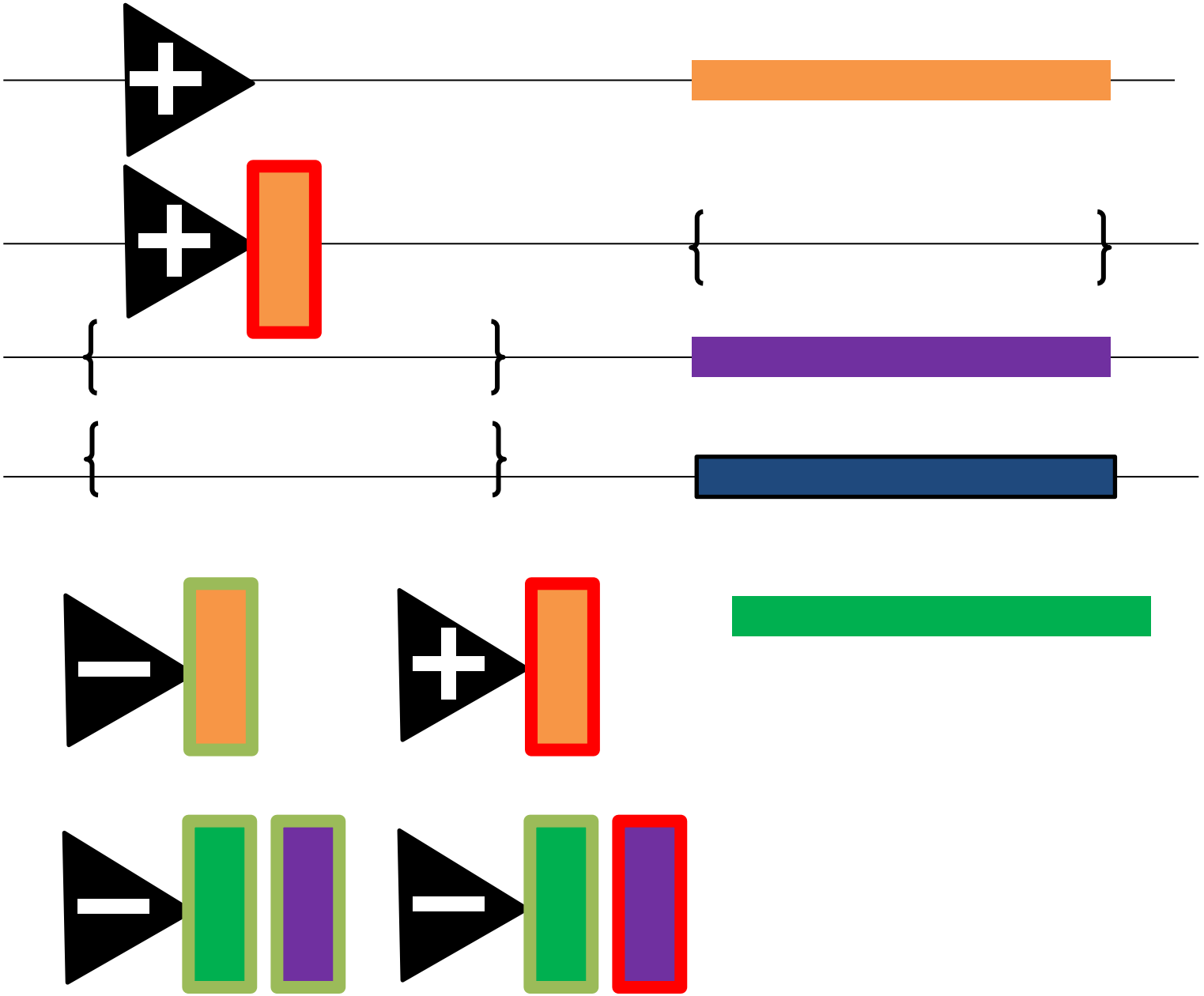
Rating: 3/10

Increase expression of the **Purple** gene in a cyclical manner.



Rating: 4/10

Increase expression of the **Blue** and **Purple** genes

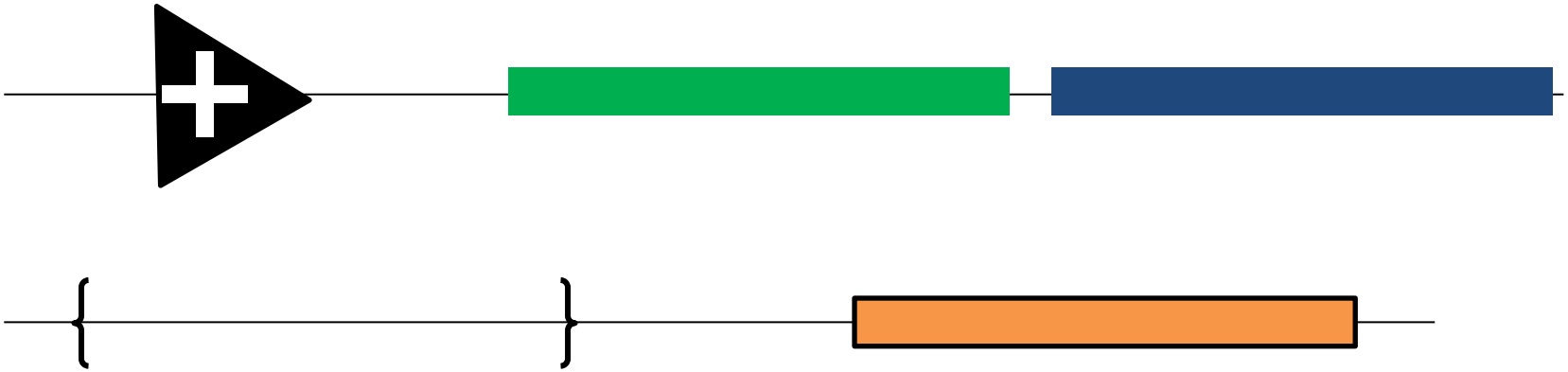


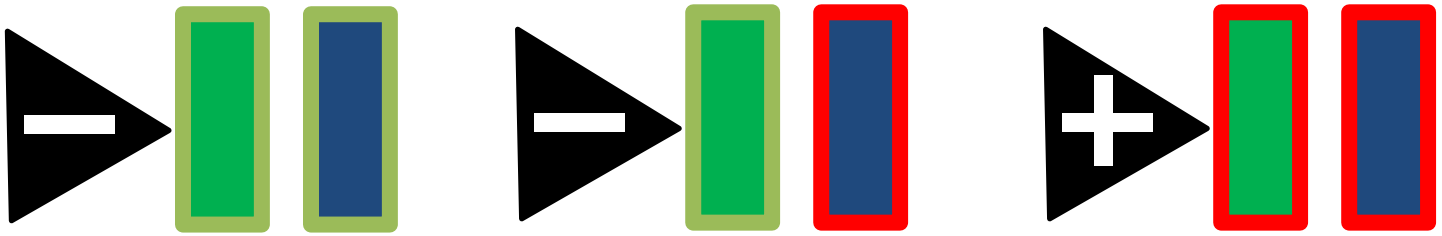
Rating: 4/10

Phase III

Polycistronic Genes

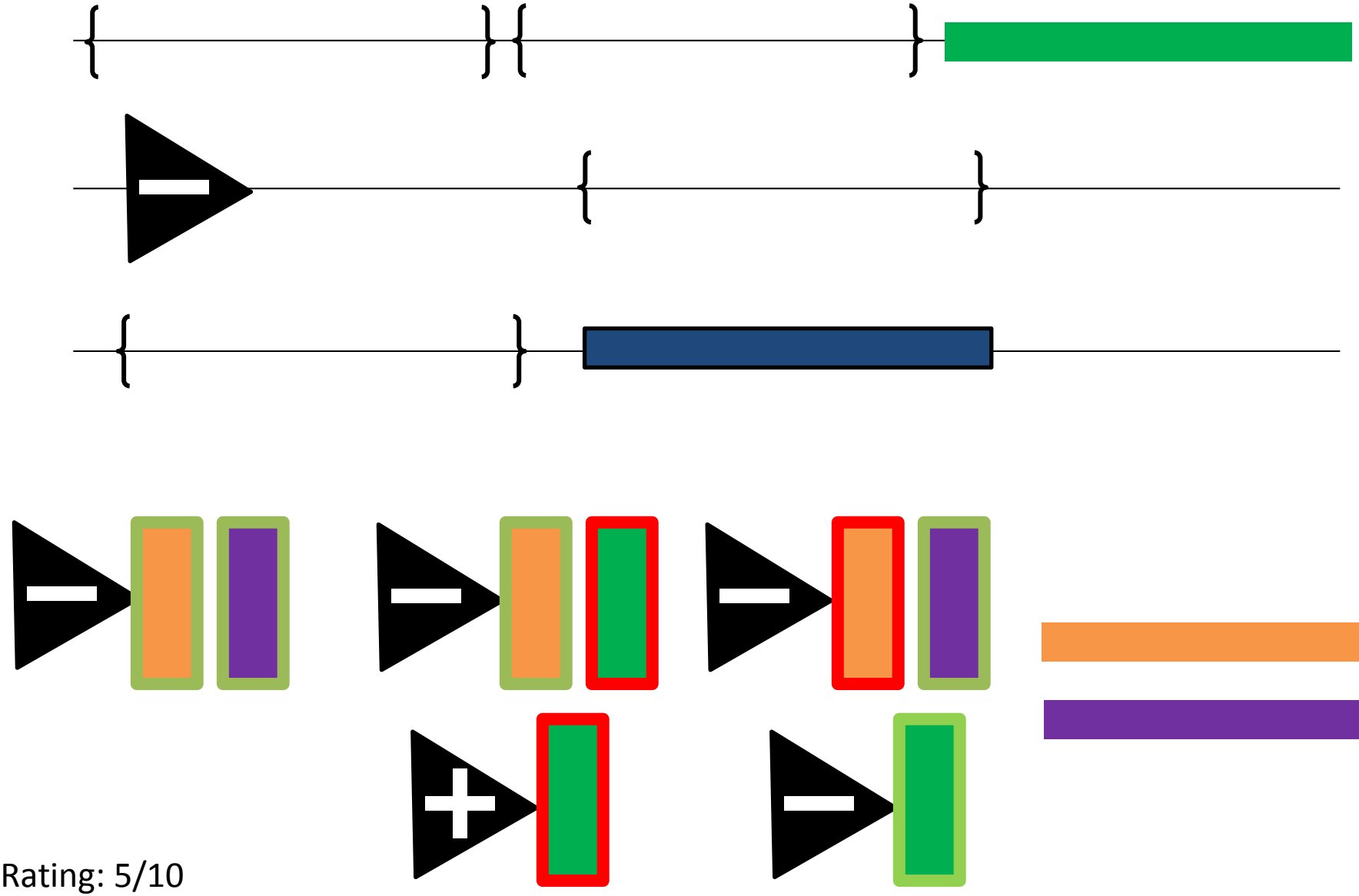
Increase expression of the **Orange** gene





Rating: 2/10

Increase expression of the **Blue** gene



Rating: 5/10

Phase IV

Training Wheels Off

If the **Orange** gene is expressed, the **Blue** gene is expressed.
If the **Blue** gene is expressed, the **Green** gene and **Orange** gene will be expressed.

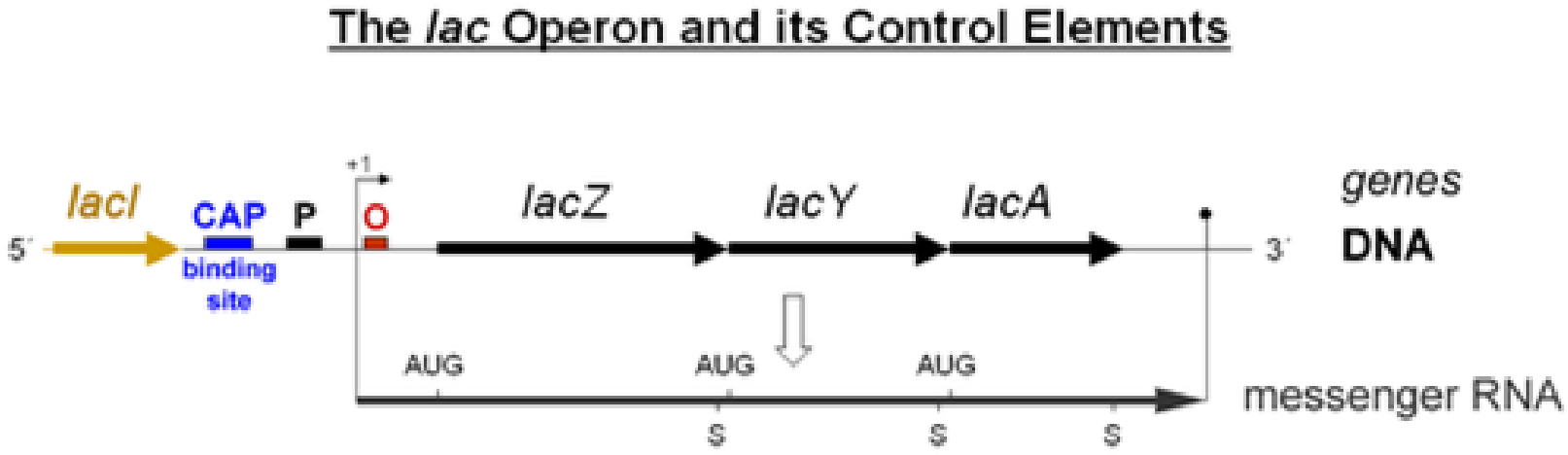
Rating: 3/10

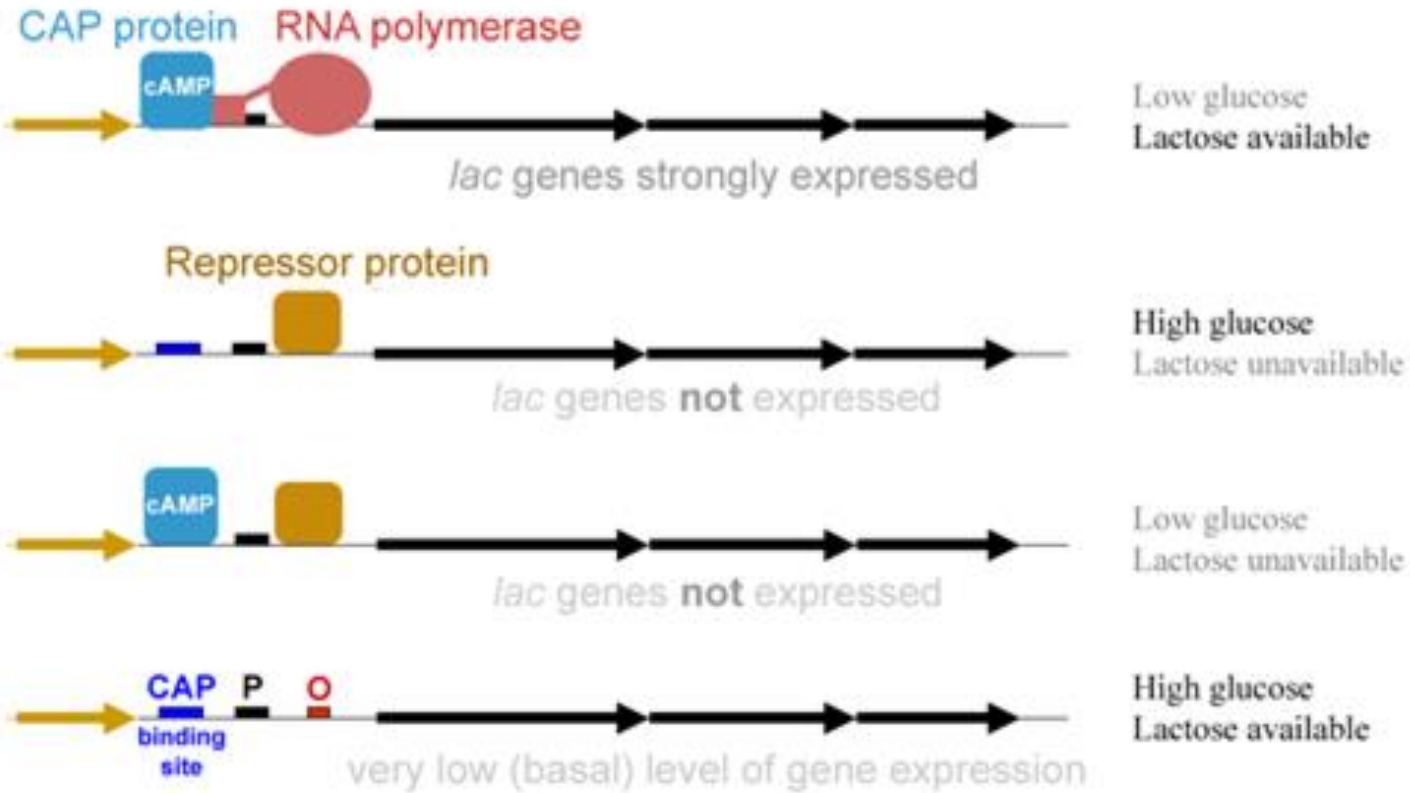
Promoter **A** controls a **Blue** gene.
Promoter **B** controls a **Purple** gene.
Promoter **C** controls an **Orange** gene.
Promoter **C** only works when Promoter **A** is **On** and Promoter **B** is **Off**.

Rating: 6/10

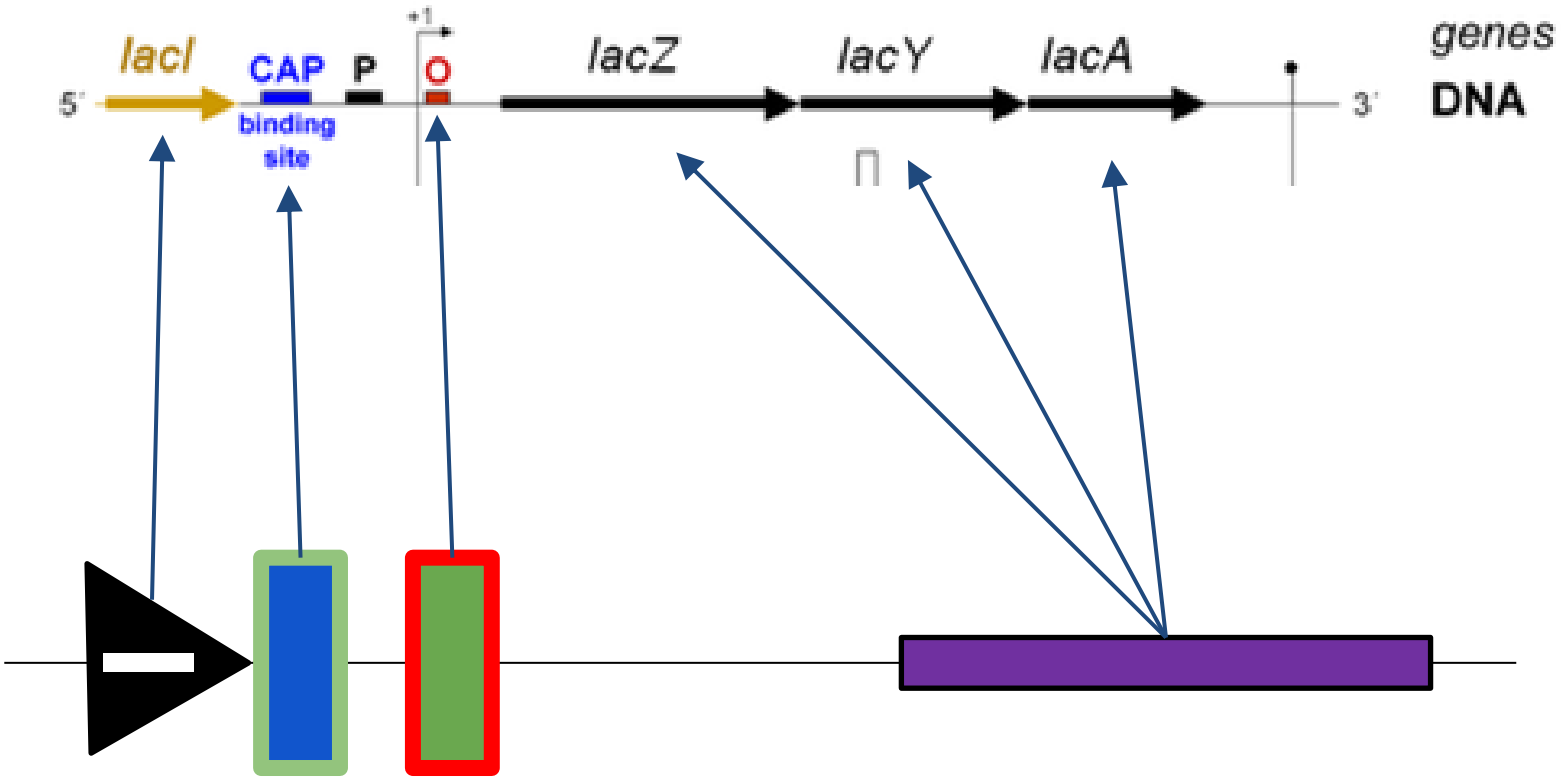
Genetic Puzzles

- A representation of real world gene control




CAP protein
RNA polymerase
cAMP
lac genes strongly expressed
Low glucose
Lactose available
Repressor protein
lac genes not expressed
High glucose
Lactose unavailable
cAMP
lac genes not expressed
Low glucose
Lactose unavailable
CAP
P
O
binding site
very low (basal) level of gene expression
High glucose
Lactose available

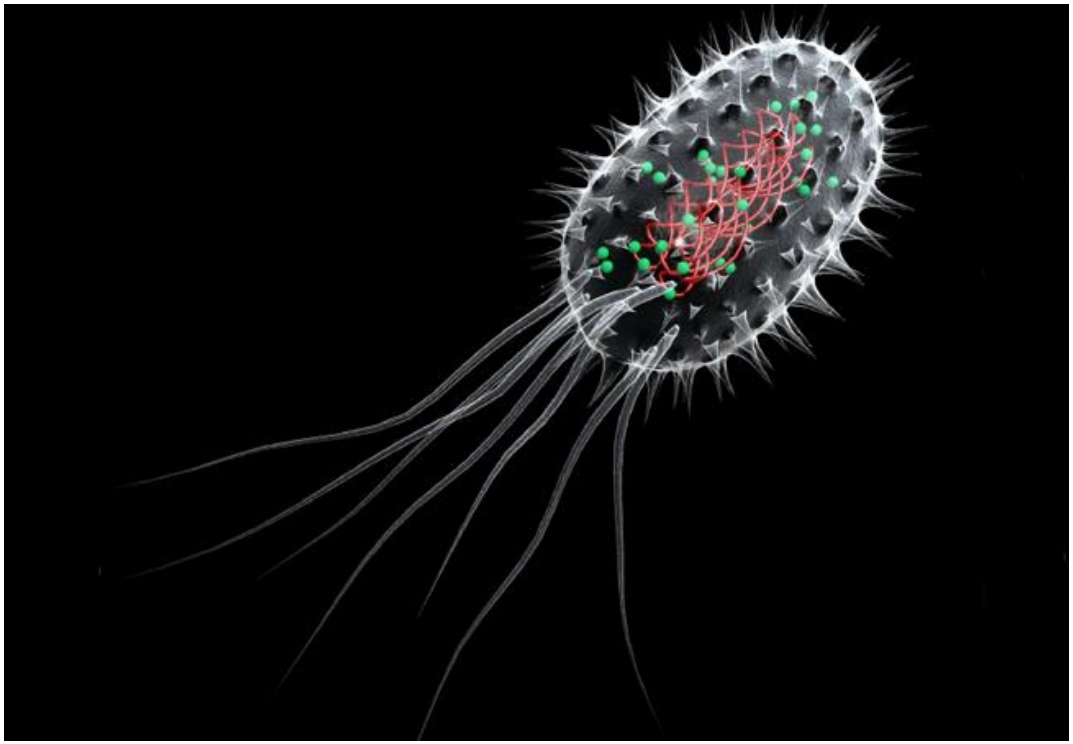
The *lac* Operon and its Control Elements



The need for control

The need for control

- Real-world applications come with risk
- Case study: Therapeutic bacteria



The need for control

- Bacteria can kill cancer *in vivo* through the production of anticancer drugs
- Anticancer drugs are highly toxic
  - Kill normal cells
- Production of drugs must be controlled.

Tumor environment

- Low oxygen
- Lots of bacteria

Production

Body Environment

- High oxygen
- Low bacteria

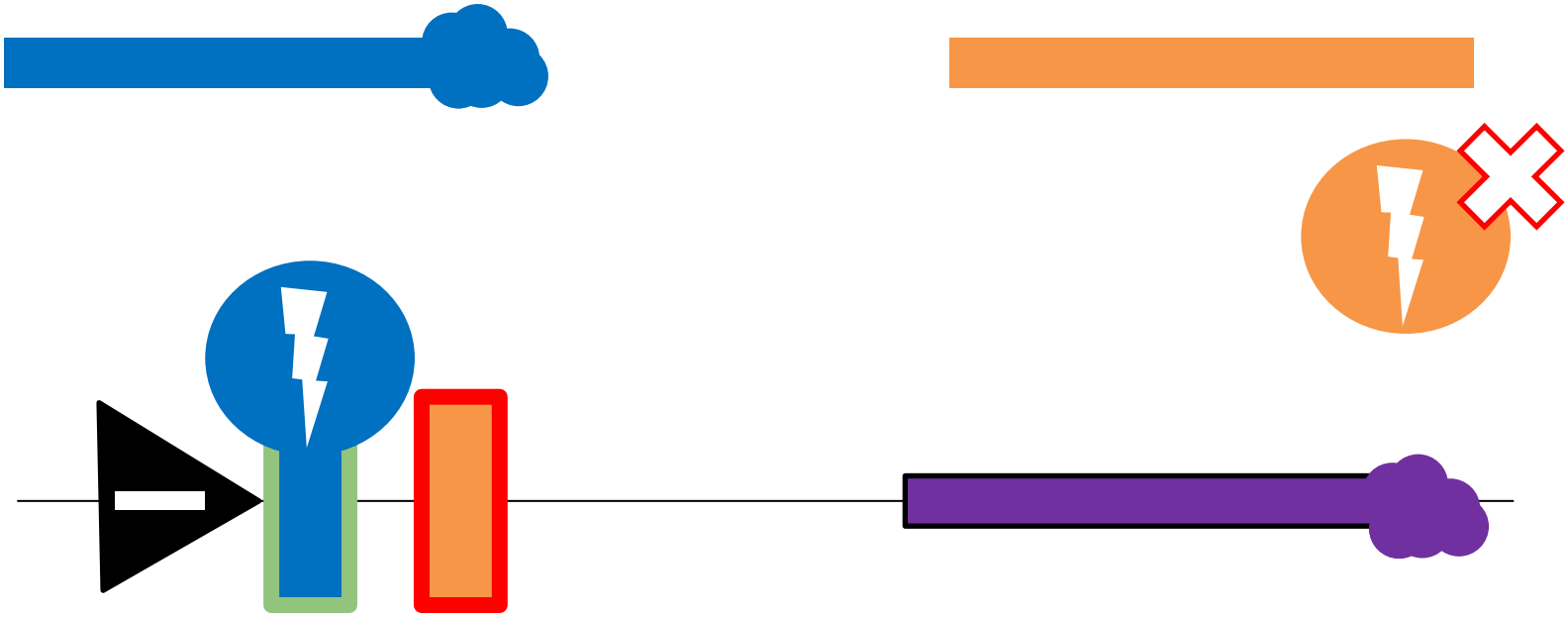
No production

~~High oxygen~~

Low oxygen

~~No other bacteria~~

Other bacteria present



END OF PRESENTATION